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ABSTRACT

Kindergarten experimental group subjects and Head Start children received classroom instruction about and "hands-on" experiences with computers, while a kindergarten control group received the "hands-on" experiences only. During an initial classroom instructional phase, a mini-unit was employed to introduce 10 computer terms to the children. Components of the mini-unit were: the Hinitz-Galen Matrix boards, age appropriate instructional games, songs, card games, visual aids, and group discussion and activities. Children were asked to name the 10 computer parts in a pretest and two posttests administered at different times. Results indicated that, in general, children in the kindergarten experimental class who were interested in both computer usage and the information in the instructional phase benefited most, in comparison with the kindergarten control and Head Start class. While the children in the control class improved in ability to remember the 10 terms, they generally scored lower than experimental subjects. Head Start class test values generally were approximately equal to or higher than the values obtained for the kindergarten control class, although Head Start children were about 1 year younger than the control subjects. It is concluded that the initial classroom instructional phase appears to have provided advantages to the Head Start and kindergarten experimental children which are not obtained solely by hands-on experience with the computer. (RH)

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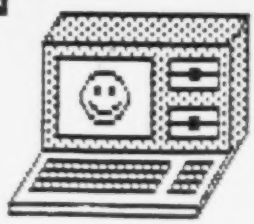

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# DEVELOPMENTAL COMPUTER AWARENESS: RESPONSES OF HEAD START AND KINDERGARTEN CHILDREN

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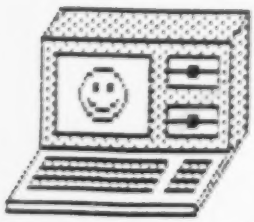


CHILD DEVELOPMENT ASPECT OF OUR COMPUTER RESEARCH

In our research with young children we designed activities and materials that were appropriate to their cognitive, social, and physical development. For the cognitive aspect, we relied heavily upon Jean Piaget's stages. We also integrated aspects of Lassar Gotkin's Interdependent Learning Model which is based on a synthesis between Piaget's theories and the Programmed Instruction approach to learning.

COGNITIVE DEVELOPMENT

Piaget--Cognitively most preschoolers and kindergarteners are in Piaget's pre-operational stage of development. This means that the child is egocentric and thus is not able to shift his attention from one aspect of a situation to another or to focus on several aspects of a situation simultaneously. In speech, he cannot pay attention to both the other's point of view and his own, so he centers on his own. In rules, he cannot consider both his own interests and others' needs so he frequently breaks rules. In reasoning, he focuses on a limited aspect of the problem. He neither reasons from the general to the particular (deduction), nor from the particular to the general (induction). Instead his reasoning lies somewhere between deduction and induction. He reasons from particular to particular, and ignores the general. Indeed, the young child may see a relationship between two or more particulars, often concrete items, where none exists. To illustrate, a child may conclude that he has not had his bath so it is not night. The child's thought has proceeded from the bath, one particular, to the night, another particular.

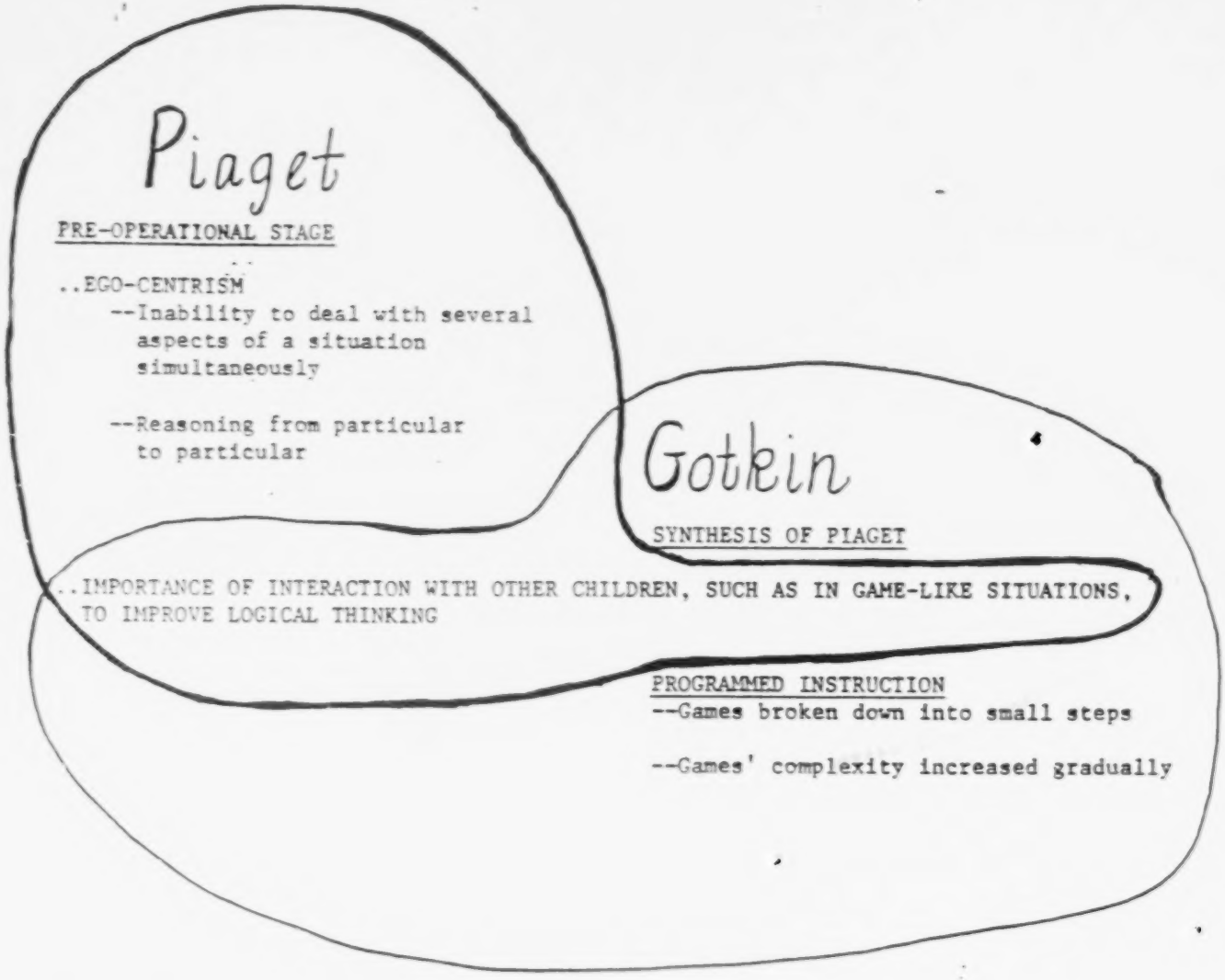
He reasons that the night depended on the bath.

As the child grows older and encounters opposing points of view and varied social situations, his thought pattern changes, and he gains the ability to view something from a perspective which differs from his original one. This process is known as decentering. Cooperation, or the coordination of points of view, can take place only when the child has begun to decenter. Then, in speech he is able to consider both his own and others' points of view. He likewise considers others' interests as well as his own in games, and is, therefore, willing to both follow and modify rules. In reasoning, he endeavors to consider both the similarities and differences within the same set of events. (Ginsburg and Opper, 1969)

(Insert Figure 1 about here) (PIAGET - GOTKIN)

According to Piaget, interactions with other children, such as in game-like situations, are important to the young child for many reasons. For example, children can more easily decenter and coordinate points of view with other children than with adults because child-child viewpoints are more similar than are child-adult viewpoints. Then too, while logical thinking cannot be taught directly, especially to a child in the pre-operational level, social interactions have the powerful effect of motivating the young child to feel obliged to make sense and be logical so that his peers can understand and believe him. (Kamii and DeVries, 1981)

Gotkin--Gotkin developed the Interdependent Learning Follow-Through Model for disadvantaged children in grades K-3. This prototype was built upon small group learning in which control


Piaget
PRE-OPERATIONAL STAGE
..EGO-CENTRISM
--Inability to deal with several aspects of a situation simultaneously
--Reasoning from particular to particular
Gotkin
SYNTHESIS OF PIAGET
..IMPORTANCE OF INTERACTION WITH OTHER CHILDREN, SUCH AS IN GAME-LIKE SITUATIONS, TO IMPROVE LOGICAL THINKING
PROGRAMMED INSTRUCTION
--Games broken down into small steps
--Games' complexity increased gradually

# Theoretical Basis

Figure 1

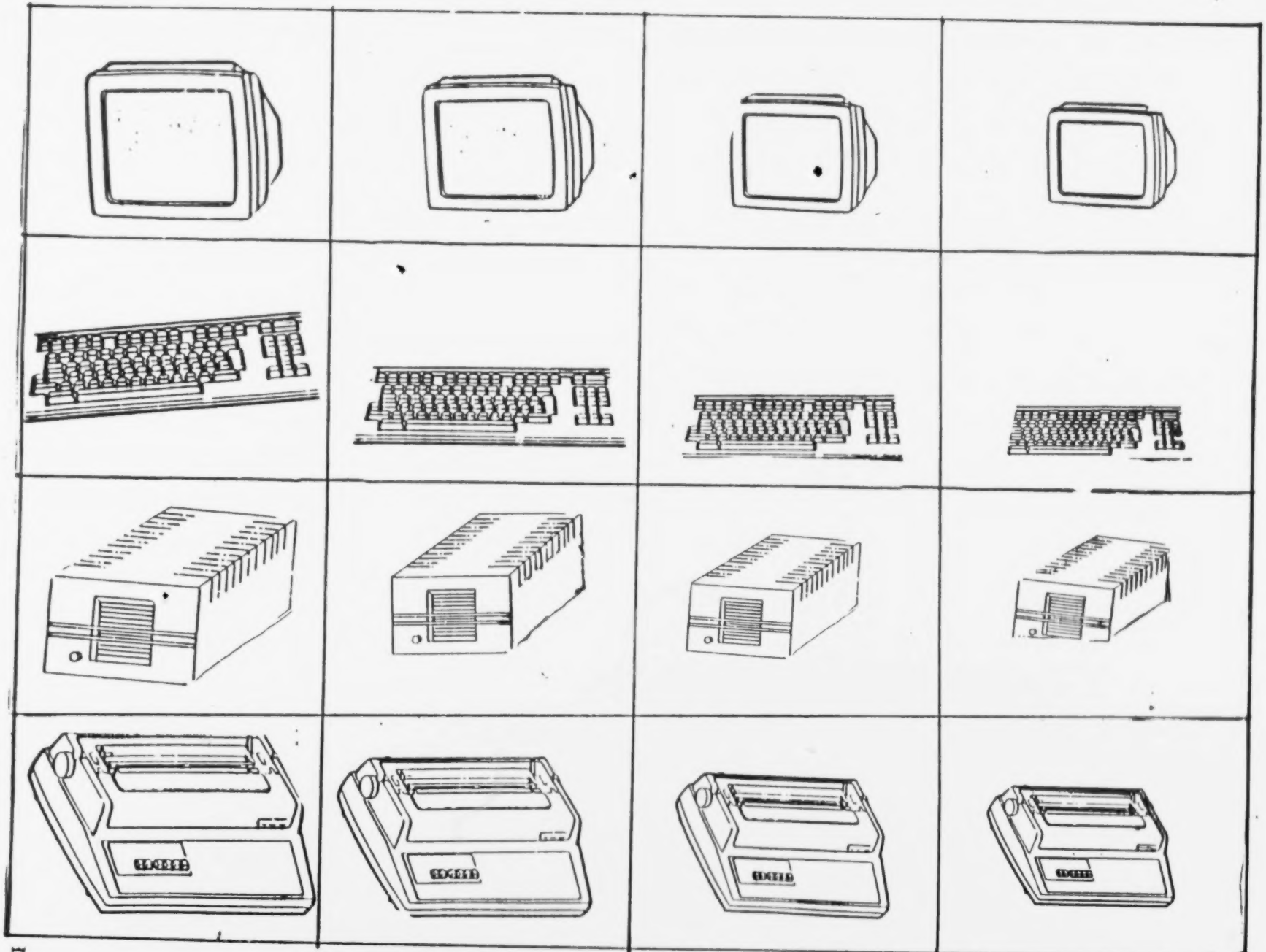
was ultimately transferred from the adult to the children, thereby increasing the children's interdependency and decreasing their teacher-dependency. Often the small group interaction took the form of Gotkin's original transactional instructional games. Each of these games required active physical and verbal involvement of players in following the games' rules, served as the vehicle for presenting a variety of instructional contents to meet multiple objectives, and gave children the opportunity to take over the role of the adult educator and teach each other. Also, the instructional content of the games was broken down into sufficiently small steps so the children could master them. Furthermore, the games gradually increased in complexity. Finally, the games provided feedback about the affective needs of children. (Gotkin, 1967)

SOCIAL DEVELOPMENT

We know that a young child's social life will increasingly be spent more with peers and less with adults. Consequently, we designed matrices, card games, and unit materials which should encourage the child's socialization.

Another of our primary considerations was the affect of the child. Therefore we emphasized Gotkin's method of feedback. In his approach, the child is never told, "You are wrong." or "That's the wrong answer." Thus, the child's self-concept is left intact. The accentuation of the positive reinforces his confidence and helps him feel in control and willing to practice unmastered skills.

(Insert Figure 2 about here) MODIFIED COMPUTER MATRIX



MODIFIED GALEN/HINITZ COMPUTER MATRIX

Figure 2

Consider three examples of characteristic Gotkin feedback :

1. The teacher has told Sally to put a purple circle on the picture of a monitor on the matrix. Sally put a purple X on the monitor and says,"I put a purple X on the monitor." The teacher lets the answer stand because Sally correctly identified what she had done even though she did not retain all of the teacher's direction.

2. The teacher has asked Brian to put a green line on the keyboard drawing on the matrix. Brian puts a green circle on the keyboard. Teacher responds, " Brian, did you put a green line or a green circle on the keyboard?" Brian removes the green circle and affixes the green line. Teacher comments, "That's right, Brian. Please tell me what you did." The teacher gave Brian an alternative choice, thereby providing him an opportunity to recognize his error and self-correct.

3. The teacher directs Cindy to put a green X on the largest printer on the matrix. Cindy puts the green X on the smallest printer on the matrix. Teacher asks, "Class, did Cindy put a green X on a printer?" Class choruses, "Yes." Teacher continues, "Class, did Cindy put a green X on the largest printer?" Class responds, "No, Cindy put a green X on the smallest printer." The teacher emphasized the correct part of Cindy's answer first and then concentrated on the incorrect part.

If the adult teacher models this type of feedback, children will adopt it when they serve as teachers.

Initially, when we designed the hands-on portion of our project, we were concerned about the effect that operating computers would have upon children's socialization,

self-confidence, and sense of worth. Through informal observations of the children's actions while they worked on the computers, we made the following discoveries, most of which have been substantiated in the literature (Bowman, 1983; Spencer and Baskin, 1983; Siegel, 1984; Schwartz, 1985):

1. Computer utilization stimulated verbal interaction among the children.
2. Use of the computer seemed to give some children the feeling of power or control over their environment. They demonstrated more independence and confidence when at the computers.
3. A number of kindergarten children evidenced a longer attention span for computer-assisted instruction of basic skills than they did for that instruction presented in more traditional forms.

PHYSICAL DEVELOPMENT

Four-, five-, and six-year-olds move with agility, vitality, and enjoyment. They absorb new concepts through their hands, arms, legs, and bodies, and well as through their eyes, ears, and to a lesser extent, mouths and noses. Since they tend to be active learners, we provided them with computer-related games which encouraged them to exercise this mode of learning. Two examples are the Turtle Game and Computer Word Syllable Jump.

(Insert Figure 3 about here) TURTLE GAME (PERSON)

The Turtle Game--This activity evolved from the concerns of the Trenton State College students about making the computer language, LOGO, understandable to Head Start youngsters. The children had been introduced to the turtle on the computer screen but had difficulty with the concepts of forward, backward, left, and

Figure 3

right. Two T.S.C. students discovered that if one became the "Turtle", got on her knees, taped a triangle to her back, and responded to the young children's commands by moving a given number of steps (actually crawls) in the designated direction, the children understood. Eventually, individual four-year-olds took turns at being the "Turtle" while a classmate gave commands and others watched to make sure the turtle complied.

Computer Word Syllable Jump--When kindergarteners had trouble remembering the names of unfamiliar computer terms, this activity was created. First, the children listened for the number of parts in each new term. Then they jumped, hopped, stomped, slapped (own thighs) or clapped each syllable as they verbalized it. Subsequently when a child could not recall a specific term, he often automatically clapped or jumped the syllable(s) and retrieved the name.

MAIN OBJECTIVE OF STUDY

One of the main objectives of this study was that at the year's end the children should be able to correctly remember, and name, as many of the different parts of computers, to which they had been introduced, as possible.

MODIFICATION

During the first two school years of our experimental program, we developed several series of games to enable the children to learn computer terminology and concepts. The first of these, which we presented at last year's conference, were the Galen-Hinitz Matrix Boards, used during 1983-4.

(See Figure 2) MATRIX

The original four by four boards contained pictures which ranged from small to large, but included two middle-sized pictures on each line, making it difficult for children to comply when asked to place a shape on the middle sized picture. The Galen-Hinitz boards contained monitors with and without pictures, keyboards, central processing units, printers, with and without people. Matrices three and four also included the concepts above/below, (over/under), next to, and to the right/to the left of. (Hinitz and Galen, ERIC - ED 252 314)

In 1984-5 we developed the Hinitz-Galen Matrix Boards to overcome the problems of the original Galen-Hinitz Boards. These new models were three by three. They were limited to one idea per board. Matrix One dealt with the entire computer system. Matrices Two and Three depicted monitors, keyboards and CPUs. Matrix Four dealt with disks, disk drives, tape recorders and tapes. The

Hinitz-Galen Boards developed thinking skills, vocabulary, and social skills.

During the 1984-85 school year, in addition to the Hinitz-Galen matrices, we introduced several card games. We reasoned that card games could more easily be incorporated into existing learning centers. We felt that the children could manipulate the smaller card games more easily than the matrix boards, and that this would allow them to take control of the situation more quickly. Of the six card games we prepared, the younger children seemed to enjoy Go Computer and Computer Concentration most. In your handout are illustrations of the pictures we used for our card games, which you can use to make games for your own classroom. [See our article in the current (Fall, 1985) issue of Day Care and Early Education, for complete instructions on each game.] (Later you will have an opportunity to prepare a game to take home with you).

The card games we devised may be used in early education settings where there are no computers, as well as those which provide computer access for children. In those centers/schools where computers are always available in the classroom along with traditional early childhood materials, (in a learning center, and/or during the work-play period) the card games may be used prior to the children's exposure to the computer, or as concept reinforcement devices. In centers where children are taken to a computer lab once a week, or have limited access to the real computer, the card games, along with the hands-on activities, such as those mentioned in the following "1984-85 Classroom

Instructional Segment", can also be used as introductory reinforcement materials.

DESIGN

a) Pretest, Post-test, Post-test

In September, 1984, the pretest you have seen demonstrated, was administered individually to each child, to ascertain his/her knowledge before the beginning of the study. At the end of the classroom instructional phase, in November, 1984, the first post test was administered individually to each child, using the same materials. In June, 1985, at the end of the hands-on phase, a second post-test was administered individually to each child, using the same materials.

b) Groups in Study

Real classroom situations were employed, using existing conditions, materials, and supplies. No attempt was made to change any classroom situation into an artificial laboratory condition. The Head Start class had no control group. (The children were about one year younger than the Kindergarten children.) In the Kindergarten, one class was the experimental group, and another class was the control group. Classes were used on an "as is" basis, so that some children left before the study concluded, and other children came in after the beginning of the study.

1984-85 CLASSROOM INSTRUCTIONAL SEGMENT

During an initial classroom instructional phase, a mini-unit was employed to introduce ten computer terms to the children. They were: monitor, CPU, disk drive, disk, keyboard, tape recorder, tape cassette, printer, joystick, and mouse. Components

of the mini-unit were: the Hinitz-Galen Matrix boards, age appropriate instructional games, songs, card games, visual aids, and group discussion and activities. In addition, the Head Start children were shown an IBM Display Writer in an office setting, as a visual introduction to what real working computers could look like. At this time the children did not take part in formal computer sessions. The Kindergarten children had a computer in the classroom, but it was left unplugged.

Some of the activities were: experiences with shoe box disk drives, dramatic play props, robot toys, and with large keyboards of different materials. Additional activities included: creating and recording of computer fantasy stories on tape, listening to books, writing experience stories, and taking field trips. Now I'd like to share some of the specific aspects of the mini-unit from 1984-85.

Children's Recorded Fantasy Stories

At Ewing Head Start, on the Trenton State College campus, undergraduate students preparing to become speech teachers tape recorded the children's descriptions of and stories about numbered cartoons and caricatures of computers appearing to do human activities. (I'd like to play one of these tapes for you now to give you a feeling for the kinds of comments the children made. Tape was then played).

Group Discussion

We presented a series of specific concepts during group discussions with the children. These were designed to help the children learn about the basic functions of parts of the computer

by comparing them with the functions of parts of the human body. The concepts which were taught were:

(Insert Figure 4 about here) PERSON WITH PARTS

1. A. You are a person (boy/girl). Your body has many parts.
   B. A computer is a machine. It has many parts.
2. A. The parts of your body work together so you can do many things.
   B. The parts of the computer work together so it can do many things.

(Insert Figure 5 about here) COMPUTER

3. A. Each part of your body has a specific job.
      (1) Some body parts help us to find out things.
      (2) Some parts help us do things.
   B. Each part of the computer has a specific job, function or purpose.
      (1) Parts of the computer that let us tell the <u>computer</u> things (information) are <u>input</u>. They help the computer find out things.
      (2) Parts of the computer that tell <u>us</u> things (information) are <u>output</u>

(Insert Figure 6 about here) BRAIN

4. A. There are some parts of our body we can't see. The brain tells the parts of our body what to do and makes our body work. We know it is there when the parts of our body work.
   B. There are some parts of the computer we can't see. The central processing unit (CPU) is inside the case. It tells the computer what to do and makes the computer work. The computer will not work without the CPU.

Figure 4

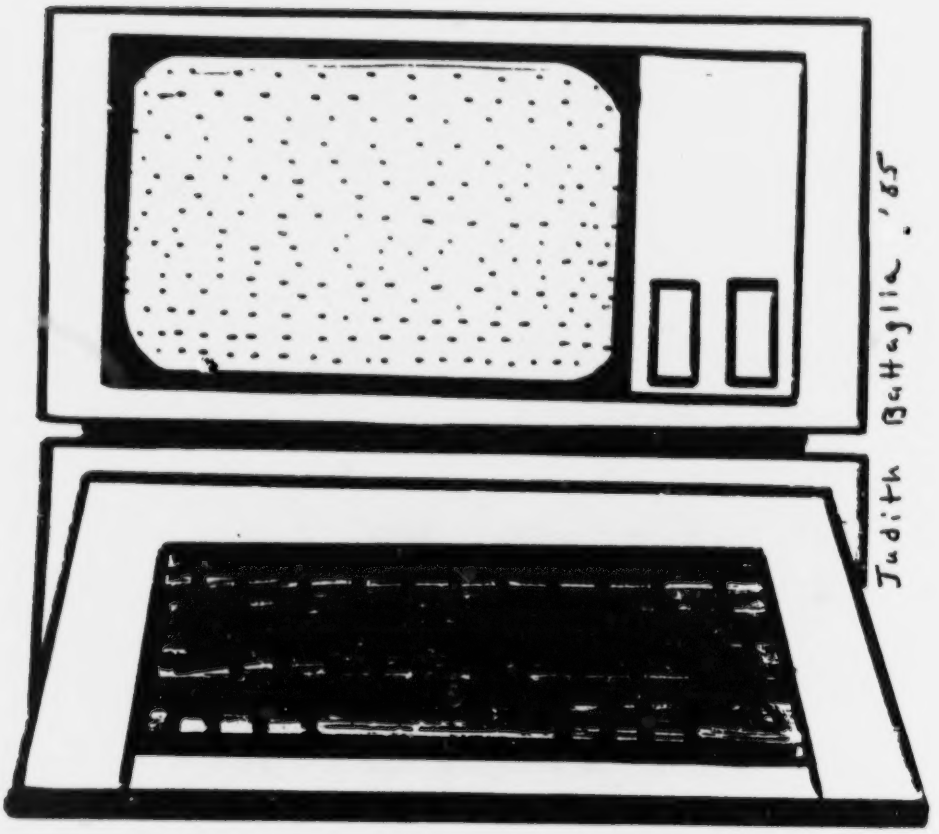



Figure 5

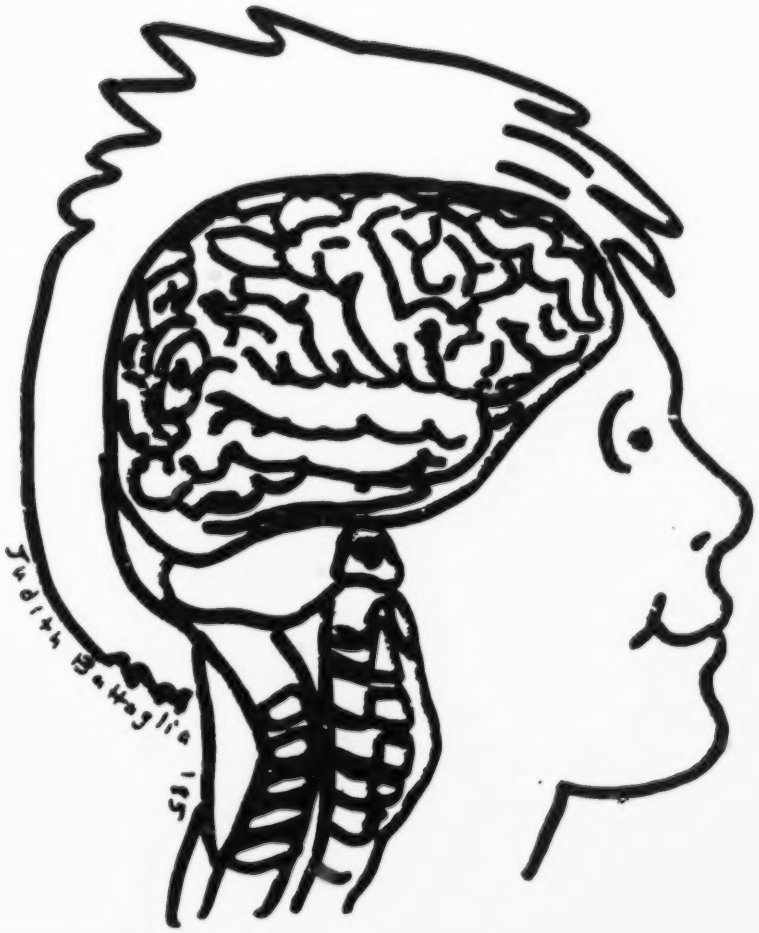


Figure 6

## 1984-85 HANDS-ON PHASE

After the classroom instruction phase was concluded, the children were introduced to the "hands on" phase, in which active participation was encouraged, but not mandatory. Regular, hands on, periodic sessions introduced the children to the hardware, and to techniques and procedures for working with the equipment. The children used the capabilities of the computers to achieve particular desired results, with commercial instructional games and programs, such as: Facemaker, Sesame Street Letters and Numbers, MECC programs, Computergarten, and LOGO.

From January to June, 1985, the Head Start children were taken, on a voluntary basis, to the TSC computer laboratory. During twenty minute sessions, they were able to work individually or in pairs, with Apple computers, under the guidance and encouragement of student volunteers, a graduate assistant and two professors. They loaded disks into the disk drives, and pressed the appropriate keys on the keyboard to achieve desired results on color monitors.

Commodore VIC 20 computers with tape recorders and Commodore 64 computers with disk drives were available to the kindergarten classes. The VIC 20 computers were physically present in the classroom throughout the entire year. During the initial instructional phase, no specific reference was made to this computer hardware and no effort was made to encourage nor discourage its use. The Commodore 64's were in a computer lab, to which the children were taken approximately twice a month for twenty to thirty minute periods. Again there were one or two

students with each computer. No printer output was used.

During this hands on phase, no formal nor specific effort was made to practice the use and repetition of the ten correct computer terms. A reason for this procedure was to determine how many of the names the children would remember by themselves, as casually and informally reinforced by the hands on usage of the computer hardware. This procedure also coincided very well with the lack of extra time within the classroom setting, during which all of the other mandated objectives of the programs had to be more specifically dealt with.

In May, 1985, a second post test was administered in the same manner as the first. This post test was used to measure how many of the ten names the children would remember based on their exposure to both the classroom instructional phase and the subsequent hardware hands on phase.

## FINDINGS OF THE 1984-85 SEGMENT OF THE STUDY

### Tests, Measurements and Results

The following data expand upon the two main findings of the 1984-85 segment:

1. In many cases Head Start and kindergarten students in the experimental group, who took part in both the classroom instructional phase and the "hands-on" phase, did better on post test two than did the control group, which only experienced the "hands-on" phase.
2. The instructional gaming procedure brought the capability of the Head Start children up to (or better than) the kindergarten control children.

The results indicated that, in general, children in the Kindergarten Experimental class who were interested in both computer usage and the information in the instructional phase benefitted the most. They remembered the largest number of the ten computer related names through the entire school year. The values in this Kindergarten Experimental class for the tests were, in general, the highest among the three classes. These children appeared to have made the most use of the information presented during the entire year.

The children in the Kindergarten Control class showed a similar improvement in remembering the ten terms. But, the average values and the highest scores on the three tests, for the Kindergarten Control class were, in general, lower than the corresponding values in the Kindergarten Experimental class. The initial classroom instruction with the Kindergarten Experimental class appears to have beneficial effects that were not obtainable just by the hands on experience with the hardware and software, as in the situation with the Kindergarten Control class.

The Headstart class test values were, in general, approximately equal to, or higher than the values obtained for the Kindergarten Control class. The children in the Headstart class were about one year younger than the children in the Kindergarten classes.

A difference of one year is not too significant for adults, but is significant for children of 4, 5, and 6 years. The initial classroom instructional phase appears to have provided advantages to the Headstart and Kindergarten Experimental children which are not obtained solely by hands on experience with the computer.

TESTS, MEASUREMENTS, AND RESULTS

Three tests (one pretest, a first post test, and a second post test) were given, in which children were asked to name the ten computer parts. Their exact responses were recorded on a mimeographed form. Each response was given a numerical value, based on how much the children remembered of the names and/or the ways that the parts functioned or operated.

Scores for responses on pre- and post tests:

4: exactly completely correct response given by child

3: very closely related response or explanation (typewriter instead of printer)

2: computer related response is partially correct (game stick instead of joystick)

1: non-computer related response is remotely correct, and related to prior experiences (vacuum cleaner instead of mouse)

0: totally incorrect responses or no responses

Two separate total scores were obtained for each of the three tests for each child. One total score, Type 1, added only the values obtained for the completely correct responses, and ignored any partially correct information. The other total score, Type 2, was obtained by adding all values, both from the completely correct, as well as from the partially correct responses. For example, if a child's responses were: keyboard, typewriter, and game stick, the Type 1 score would be 4, because there is only one completely correct resonse, keyboard. The Type 2 score of 9, is obtained by adding 4 for the keyboard, 3 for the typewriter, and 2 for the game stick.

In these classes, there were eight possible types of patterns, A through H, over the course of the year, with the possible changes that could occur in the amount of information that the children remembered, between each of the tests.

| Test: | 1 | 2 | 3 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|
| A: | increase, | increase | | E: | decrease, | decrease |
| B: | increase, | decrease | | F: | decrease, | increase |
| C: | increase, | no change | | G: | decrease, | no change |
| D: | no change, | increase | | H: | no change, | decrease |

Type A: provides for a continual improvement by the reinforcement of the initial classroom instruction by the hands on experience with the hardware and achievement or goal oriented software

Type B: improvement during classroom phase but little or no benefit from hands on experience

Type C: similar to B

Type D: little or no apparent benefit from classroom instructional phase, but did show improvement from hands on phase

Type E: little or no benefit from instructional and hands on phases, opposite to A

Type F: similar to D, opposite to B, little or no apparent benefit from classroom instructional phase, but did show improvement from hands on phase

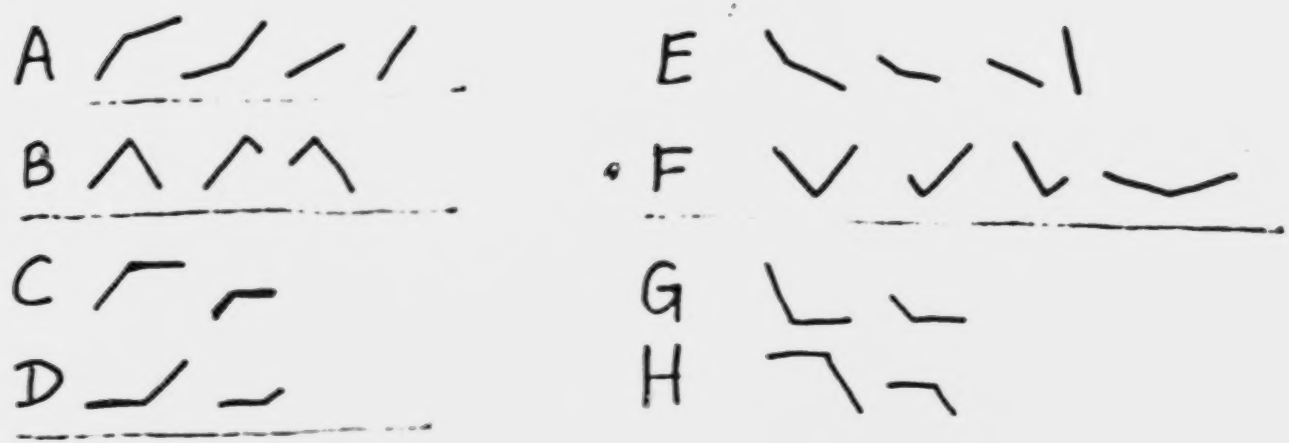
Type G: similar to E, opposite to C

Type H: similar to E, opposite to D

(Insert Figure 7 about here)

# Test Result Patterns

1: Pretest  2: Posttest 1  3: Post test 2




| Type | Test Scores |
|---|---|
| 1 | Only completely correct answers |
| 2 | All answers, both partially, and completely correct answers |

Figure 7

Table 1. Average percent values, for the sums of the scores, for all three tests, of all students in each of the three classes, showing Type 1 and Type 2 test responses, for pattern categories A through H. The Headstart (HD) class had 14 students, the Kindergarten Experimental (KE) class had 20 students, and the Kindergarten Control (KC) class had 19 students being tested for the pretest, and both of the post tests.

| TYPE 1 | | | TYPE 2 | | |
|---|---|---|---|---|---|
| HD | KE | KC | HD | KE | KC |
| 27% | 32% | 27% | 49% | 53% | 43% |

Table 2. Highest percent score value achieved by any student, in each class, only on the third test, at the end of the study.

| TYPE 1 | | | TYPE 2 | | |
|---|---|---|---|---|---|
| HD | KE | KC | HD | KE | KC |
| 60% | 90% | 60% | 80% | 98% | 85% |

Table 3. Average percent values for the sums of the scores, for all three tests, of students showing Type 1, and Type 2 test responses, according to pattern categories A, B, D, and F. The values in the parentheses indicate the percentage of the number of students, that were in those particular categories, out of all of the students in that class. The Headstart (HD) class had 14 students, the Kindergarten Experimental (KE) class had 20 students, and the Kindergarten Control (KC) class had 19 students, who were being tested with all three tests.

| Category | TYPE 1 | | |
|---|---|---|---|
| | HD | KE | KC |
| A | 32% (29%) | 36% (45%) | 29% (79%) |
| B | 29% (21%) | 31% (35%) | - - |
| D | 13% ( 7%) | - - | 18% (16%) |
| F | - - | - - | - - |

| Category | TYPE 2 | | |
|---|---|---|---|
| | HD | KE | KC |
| A | 59% (21%) | 59% (45%) | 48% (37%) |
| B | 49% (50%) | 48% (40%) | - - |
| D | 43% ( 7%) | 46% (10%) | 57% ( 5%) |
| F | 53% ( 7%) | 40% ( 5%) | 38% (58%) |

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